

NON-LINEAR DYNAMIC PREDICTIVE DEVICE

ABSTRACT OF THE DISCLOSURE

A non-linear dynamic predictive device (60) is disclosed which operates either in
5 a *configuration* mode or in one of three runtime modes: *prediction* mode, *horizon* mode,
or *reverse horizon* mode. An external device controller (50) sets the mode and determines
the data source and the frequency of data. In the forward modes (prediction and horizon),
the data are passed to a series of preprocessing units (20) which convert each input
variable (18) from engineering units to normalized units. Each preprocessing unit feeds a
10 delay unit (22) that time-aligns the input to take into account dead time effects. The
output of each delay unit is passed to a dynamic filter unit (24). Each dynamic filter unit
internally utilizes one or more feedback paths that provide representations of the dynamic
information in the process. The outputs (28) of the dynamic filter units are passed to a
non-linear approximator (26) which outputs a value in normalized units. The output of
15 the approximator is passed to a post-processing unit (32) that converts the output to
engineering units. This output represents a prediction of the output of the modeled
process. In *reverse horizon* mode, data is passed through the device in a reverse flow to
produce a set of outputs (64) at the input of the predictive device. These are returned to
the device controller through path (66). The purpose of the *reverse horizon* mode is to
20 provide information for process control and optimization. The predictive device
approximates a large class of non-linear dynamic processes. The structure of the
predictive device allows it to be incorporated into a practical multivariable non-linear
Model Predictive Control scheme, or used to estimate process properties.